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FLOOD INSURANCE STUDY



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COMPLETED
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TOWN OF
WEYBRIDGE,
VERMONT
ADDISON COUNTY



SEPTEMBER 29, 1986



Federal Emergency Management Agency

COMMUNITY NUMBER - 500174

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FLOOD INSURANCE STUDY
TOWN OF WEYBRIDGE, ADDISON COUNTY, VERMONT

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Town of Weybridge, Addison County, Vermont, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert Weybridge to the regular program of flood insurance by the Federal Emergency Management Agency (FEMA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

This Flood Insurance Study was prepared by compiling pertinent information for the flood hazard areas in the Town of Weybridge from existing technical and/or scientific data originally prepared by others for uses other than the preparation of this Flood Insurance Study. These existing data were reviewed by FEMA prior to their use in the development of this Flood Insurance Study to ensure compliance with the National Flood Insurance Program (NFIP) accuracy requirements.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these federally-supported studies are based. These criteria take precedence over the minimum federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3. In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic analysis for this study were performed by the New York District of the U. S. Army Corps of Engineers (COE). The hydraulic analysis was performed by DuBois & King, Inc., for the COE.

1.3 Coordination

On November 7, 1985, the results of this study were reviewed and accepted at a final CCO meeting attended by representatives of FEMA and the town.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Town of Weybridge, Addison County, Vermont. The area of study is shown on the Vicinity Map (Figure 1).

Otter Creek was studied by detailed methods from the downstream corporate limits to approximately 1,000 feet upstream of Weybridge Dam. The areas studied by detailed methods were selected based upon the extent and validity of available existing hydrologic and hydraulic data.

The Lemon Fair River, Beaver Brook, and portions of Otter Creek were studied by approximate methods. Approximate methods of analysis were used to study all remaining areas having a potential flood hazard that did not have available detailed scientific or technical data.

2.2 Community Description

The Town of Weybridge is bordered by the Town of New Haven to the north, the Town of Middlebury to the east, the Town of Cornwall to the south, and the Towns of Bridport and Addison to the west. Weybridge has a population of 667 and occupies an area of 11,072 acres (Reference 1).

2.3 Principal Flood Problems

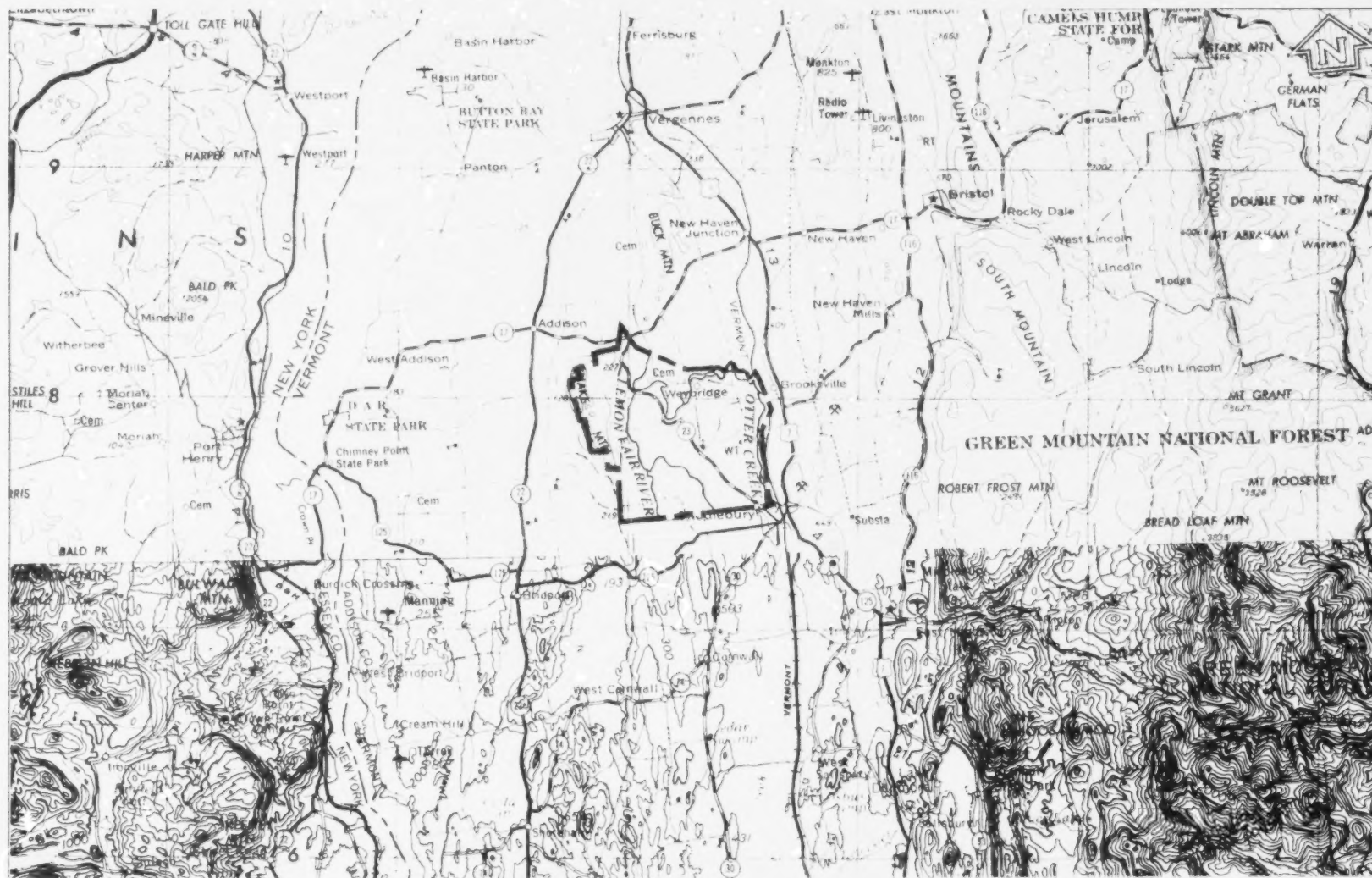
Flood problems along Otter Creek are generally associated with spring runoff and summer thunderstorms. Ice jamming has not been known to be a problem in the past, and it was not considered within the confines of this study.

2.4 Flood Protection Measures

There are no flood protection measures in the Otter Creek Watershed.

3.0 ENGINEERING METHODS

For the flooding source studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or



FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF WEYBRIDGE, VT

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APPROXIMATE SCALE



VICINITY MAP

FIGURE 1

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500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for the flooding source studied in detail affecting the community.

The design discharges for Otter Creek were developed through an analysis of the peak discharge versus frequency curve for the Middlebury U. S. Geological Survey (USGS) stream gage, which is upstream of the study site (References 2 and 3). Water Resources Council Bulletin No. 17A was used to perform the log-Pearson Type III statistical analysis of the water year peaks (Reference 4). The period of record for the Middlebury gage was from 1904 to 1906, 1911 to 1919, November 1927, and 1929 to 1983. The derived mean, standard deviation, and skew were 3.649, 0.148, and 0.259, respectively. The regional skew was determined to be 0.2, and the final adopted skew was calculated as 0.2. The information for the hydrologic analysis of Otter Creek was taken from the COE study for Otter Creek (Reference 5).

A summary of drainage area-peak discharge relationships for Otter Creek is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

<u>FLOODING SOURCE AND LOCATION</u>	<u>DRAINAGE AREA</u> <u>(sq. miles)</u>	<u>PEAK DISCHARGES (cfs)</u>			
		<u>10-YEAR</u>	<u>50-YEAR</u>	<u>100-YEAR</u>	<u>500-YEAR</u>
OTTER CREEK					
Below Lemon Fair River	866	8,908	12,114	13,616	17,306
Below Weybridge Dam	750	7,997	10,876	12,224	15,537

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the source studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross section information was obtained through field measurements. Bridge plans were used to obtain structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

Roughness coefficients (Manning's "n") for Otter Creek were estimated by field inspection at each cross section. The channel "n" values ranged from 0.040 to 0.050, and the overbank "n" values ranged from 0.060 to 0.120.

Water-surface elevations of floods of the selected recurrence intervals were computed using the COE HEC-2 step-backwater computer program (Reference 6). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. The starting water-surface elevation for Otter Creek at the confluence with Lake Champlain is based on the mean high lake level with an elevation of 99 feet (Reference 5).

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year flood plain boundaries and 100-year floodway to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps (References 7 and 8).

The 100- and 500-year flood plain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year flood plain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE), and the 500-year flood plain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodway in this study is presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodway presented in this study was computed for certain stream segments on the basis of equal conveyance reduction from each side of the flood plain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 2). The computed floodway is shown on the Flood Insurance Rate

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY	INCREASE
Otter Creek								
A	71,380	472 ²	6,207	2.2	148.2	148.2	149.2	1.0
B	71,580	377 ²	4,058	3.4	148.2	148.2	149.2	1.0
C	71,710	218 ²	3,304	4.1	148.2	148.2	149.2	1.0
D	71,840	414 ²	5,739	2.4	148.5	148.5	149.4	0.9
E	74,140	1,290 ²	13,926	1.0	148.8	148.8	149.8	1.0
F	77,140	540	7,229	1.9	149.1	149.1	150.1	1.0
G	82,340	790	8,348	1.5	149.9	149.9	150.9	1.0
H	88,840	899	8,472	1.4	150.6	150.6	151.5	0.9
I	92,840	2,254	17,187	0.7	151.1	151.1	152.0	0.9
J	96,240	361	5,612	2.2	151.3	151.3	152.3	1.0
K	97,040	1,290	8,885	1.4	151.4	151.4	152.4	1.0
L	98,955	216	2,130	5.7	151.9	151.9	152.7	0.8
M	99,505	200	2,062	5.9	152.9	152.9	153.5	0.6
N	99,705	130	2,445	5.0	153.6	153.6	154.1	0.5

¹Feet above confluence with Lake Champlain

²This width extends beyond corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF WEYBRIDGE, VT

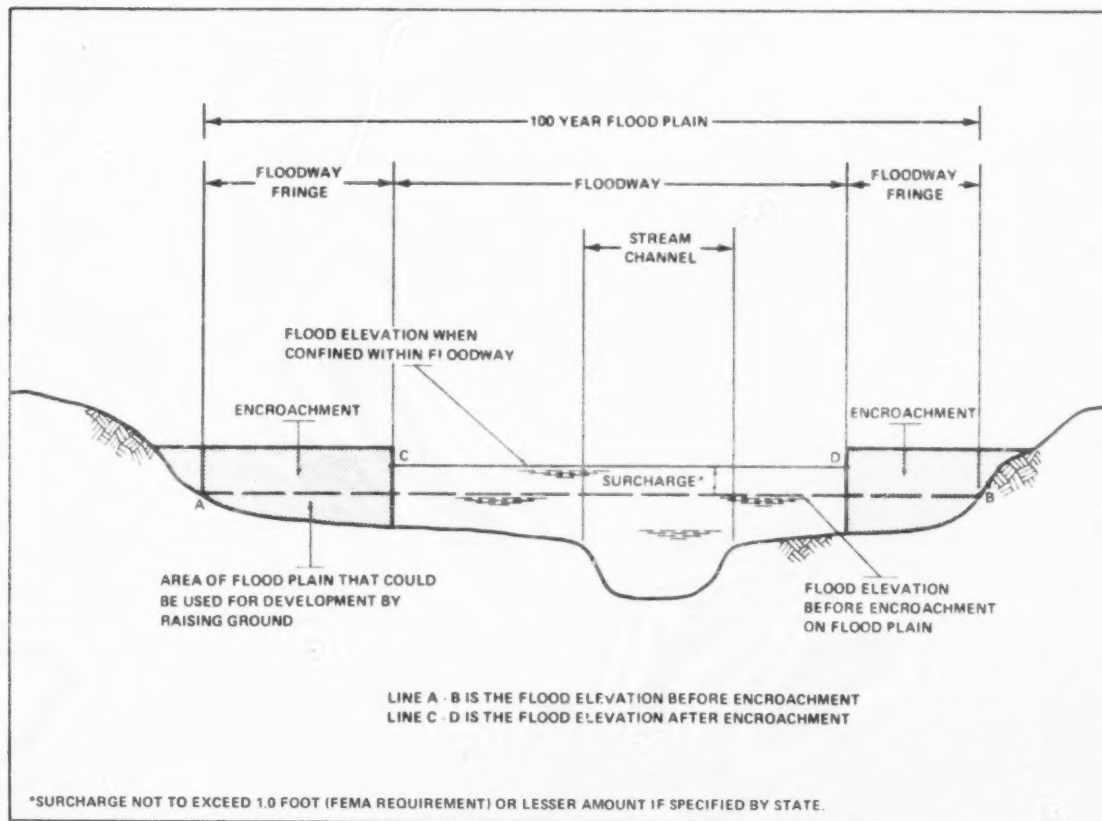
(ADDISON CO.)

FLOODWAY DATA

OTTER CREEK

Map (Exhibit 2). In cases where the floodway and 100-year flood plain boundaries are either close together or collinear, only the floodway boundary is shown. Portions of the floodway widths for Otter Creek extend beyond the corporate limits.

The area between the floodway and 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.



FLOODWAY SCHEMATIC

Figure 2.

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year flood plains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown in this area.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year flood plains that are determined in the Flood Insurance Study by detailed methods. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year flood plain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal flood plains that have additional hazards associated with storm waves. Zone V areas are determined by approximate methods, and base floods elevations are not shown.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal flood plains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year flood plain, areas within the 500-year flood plain, and to areas of 100-year shallow flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown.

Zone D

Areas of undetermined, but possible flood hazard.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and flood plain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year flood plains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For flood plain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year flood plains, the floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

7.0 OTHER STUDIES

Flood Insurance Studies for the Towns of Cornwall and Middlebury have been completed (References 9 and 10). The results of this study are in agreement with the results of those studies.

Flood Insurance Studies are currently being prepared for the Towns of New Haven and Addison (References 11 and 12). The results of this study will be in agreement with those studies.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Regional Director, Region I Office, J. W. McCormack Post Office and Courthouse Building, Room 462, Boston, Massachusetts 02109.

9.0 BIBLIOGRAPHY AND REFERENCES

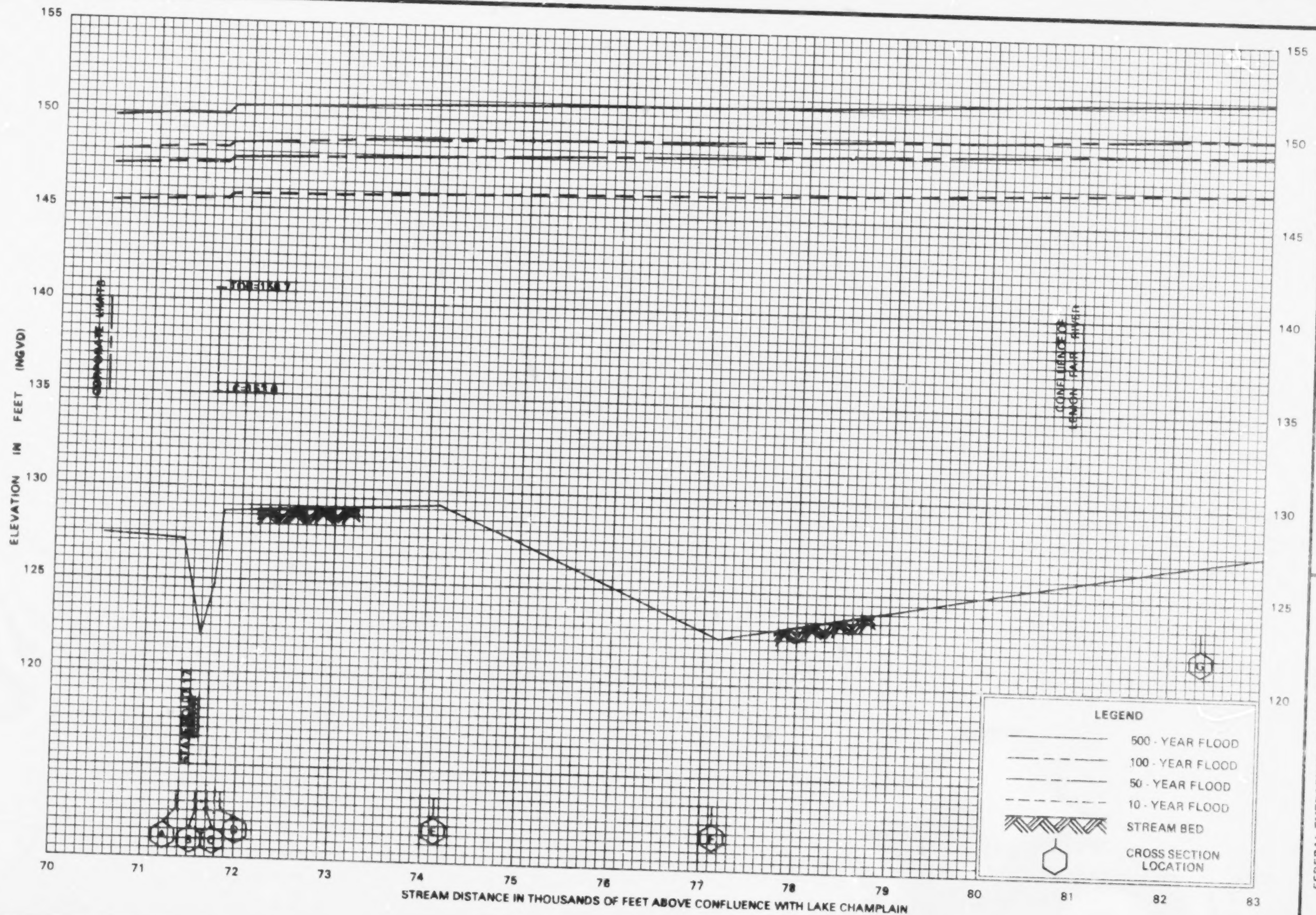
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10. Federal Emergency Management Agency, Flood Insurance Study, Town of Middlebury, Addison County, Vermont, Washington, D. C., January 3, 1985.
11. Federal Emergency Management Agency, Flood Insurance Study, Town of New Haven, Addison County, Vermont (Unpublished).
12. Federal Emergency Management Agency, Flood Insurance Study, Town of Addison, Addison County, Vermont (Unpublished).

EXHIBIT 3 - ELEVATION REFERENCE MARKS

<u>Reference Mark</u>	<u>FIRM Panel</u>	<u>Elevation (Feet NGVD)</u>	<u>Description of Location</u>
RM 1	05	155.46	Spike in root of an 18-inch maple tree, on west side of road, approximately 1.1 miles south on Quaker Village Road from State Route 17.
RM 2	05	158.24	Spike in root of 12-inch Poplar tree, approximately 700 feet north of Farm Access Bridge, approximately 60 feet east of road centerline and approximately 1.65 miles south on Quaker Village Road from State Route 17 intersection.
RM 3	05	152.57	Spike in lone 40-inch elm tree in open field, approximately 0.6 mile south along Farm Access Bridge and approximately 1.65 miles south on Quaker Village Road from State Route 17 intersection.
RM 4	05	179.99	State of Vermont disk, on the southwest corner of west abutment of east bridge over Otter Creek.
RM 5	05	202.19	U. S. Geological Survey Disk stamped 17JEA 1961, at southeast wing wall at large box culvert approximately 300 feet north of "Y" intersection, approximately 0.1 mile northwest of bridges over Otter Creek.

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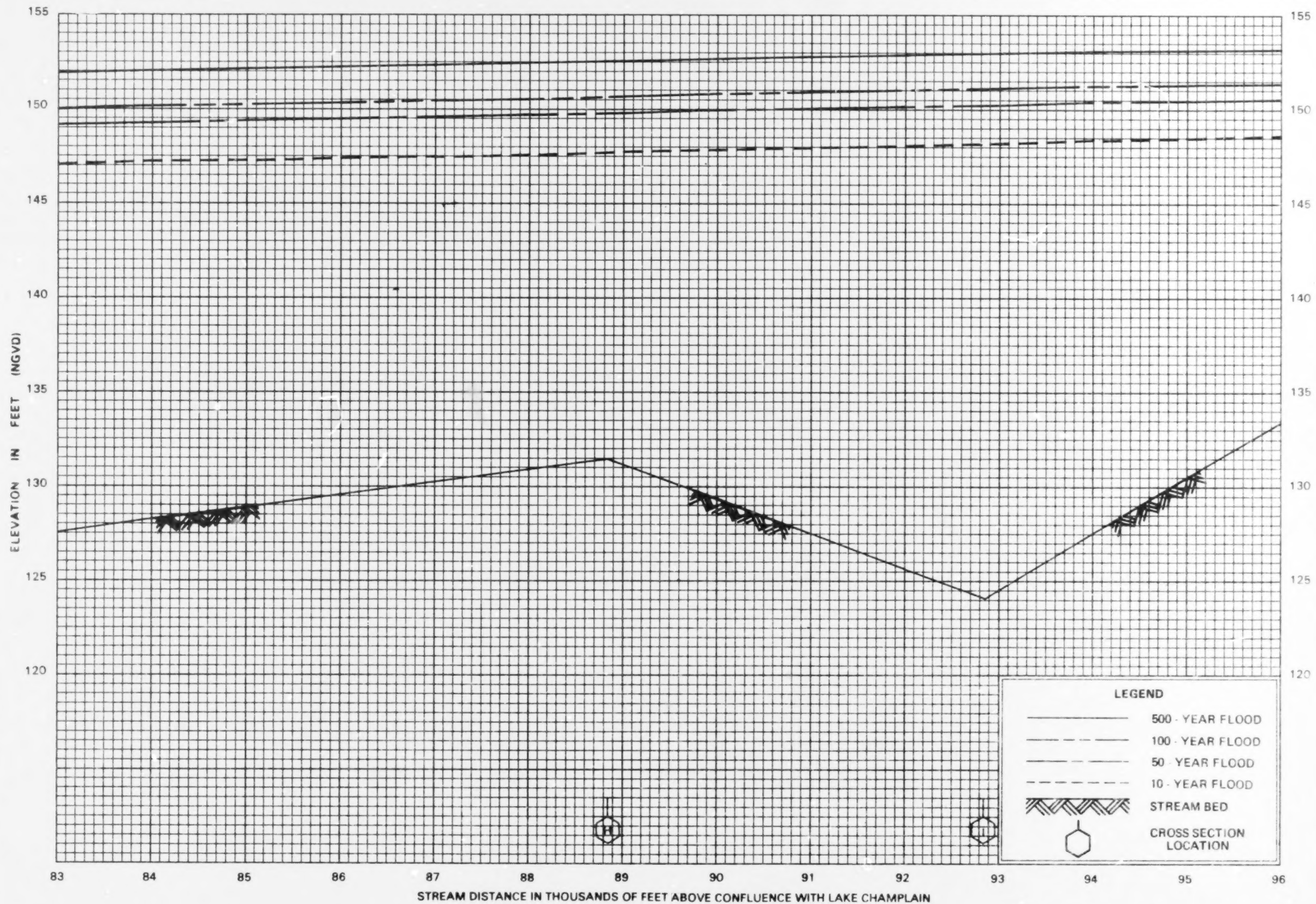
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FLOOD PROFILES
OTTER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY
TOWN OF WEYBRIDGE, VT
(ADRIANSON CO.)

01P



FLOOD PROFILES

OTTER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

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